**EM477 Computer-Aided Design**
**Rocker Mechanism Project**
**Fall 2001**

## Detail Design Information for the Rocker Mechanisms

The stock materials available for your mechanism designs are listed below along with some other technical information that you may find useful. Each team will be issued a kit box containing the following items:

**Table 1 Bill of materials for the Rocker Project Kit Box**

| Item | Quantity |
|---|---|
| #10-24 pan head, Phillips head screws | 100 |
| #10-24 Keps Lock Nut | 100 |
| #10 USS Flat Washer | 100 |
| 3/8" OD x 1/8" long, brass spacer | 12 |
| #10 HSS drill | 1 |
| #20 HSS drill | 1 |
| #30 HSS drill | 1 |
| 3/8" HSS drill | 1 |
| 3/8" combination wrench | 1 |
| Phillips head screwdriver | 1 |
| 1/8 in. dia. POP rivets | 100 |

Each team is allotted up to two 16 ft. lengths of angle and two 12 ft. lengths of flat stock. You must present your instructor with a drawing of your assembly, and a cutting schedule before you will be issued your material.

*The kit box, unused fasteners and all tools must be returned at the end of the semester. Failure to return or replace lost tools will result in an incomplete grade for the semester.*

**3/4" x 1/8" angle** - 6063-T52 aluminum, $\sigma_Y$=21 ksi, $\sigma_u$=27 ksi, $\tau_u$=17 ksi. The angle comes in 16 ft. lengths and can be cut with a hacksaw or the cut-off saw in R15. The angle is intended for the support frame of your mechanism and for the coupler assembly.

**3/4" x 1/8" flat bar** - 6061-T6 aluminum, $\sigma_Y$=40 ksi, $\sigma_u$=45 ksi, $\tau_u$=30 ksi. The bar comes in 10 ft. lengths and can be cut with a hacksaw or the cut-off saw in R15. The flat bar is well-suited for the moving links of your mechanism as well as for cross braces for the support frame and coupler.

**#10-24 pan head, Phillips head steel screws** - These are to be used for the joints in your mechanism. The screws are ½" long. They can also be used to bolt pieces of the frame or coupler together.

**#10-24 Keps Nuts** - These nuts fit the screws. They have an integral, serrated lock washer to keep them from loosening. Do NOT use a flat washer directly underneath these nuts. The serrated washer is designed to grab into the aluminum stock.

**#10 USS Flat Washers** – The washers are used under the head of the steel screws. Do not use a washer under the Keps Nut.

**3/8" OD x 1/8" long brass spacers –** The spacers will serve as bearings for the revolute joints. A 3/8" dia. hole is drilled into the moving member of the joint and the spacer is placed in the hole. The 10-24 screw fits thru the center of the spacer and serves as the axle. Figure 2 shows an exploded view of a typical joint assembly. Each group is issued 12 spacers. This should be enough to make 12 joints. Each rocker should only need 10 joints

**1/8" dia., steel POP rivets** - Blind rivets for fastening the components of your frame and coupler assembly together. Use the #20 drill to make holes for the rivets. It is probably best to drill through mating parts at the same time to ensure proper alignment.

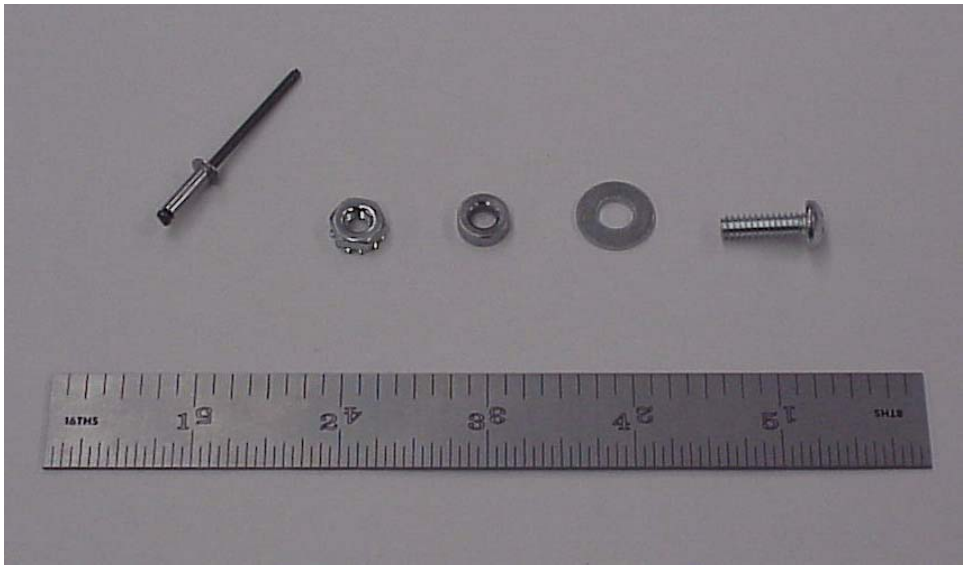

**Figure 1 (L-R) Pop rivets, flange nut, press-in bearing and shoulder bolt**

A typical joint design is pictured below:

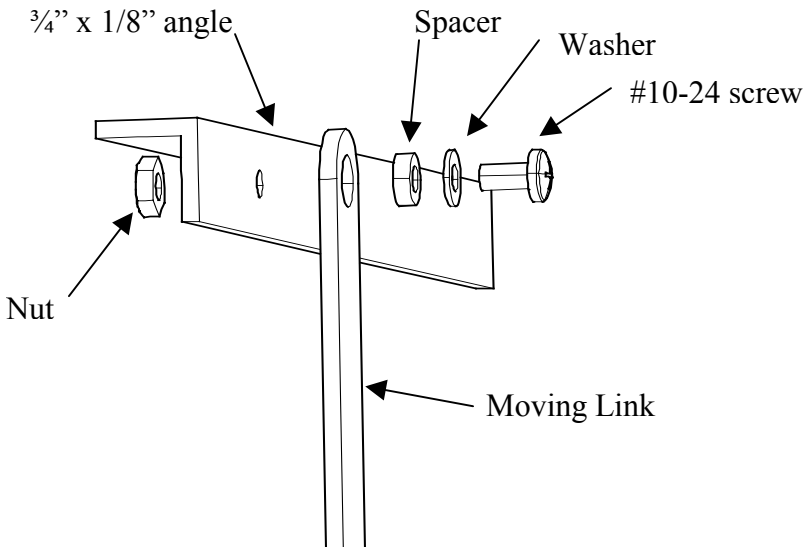


**Figure 2 Exploded view of a typical joint assembly.**

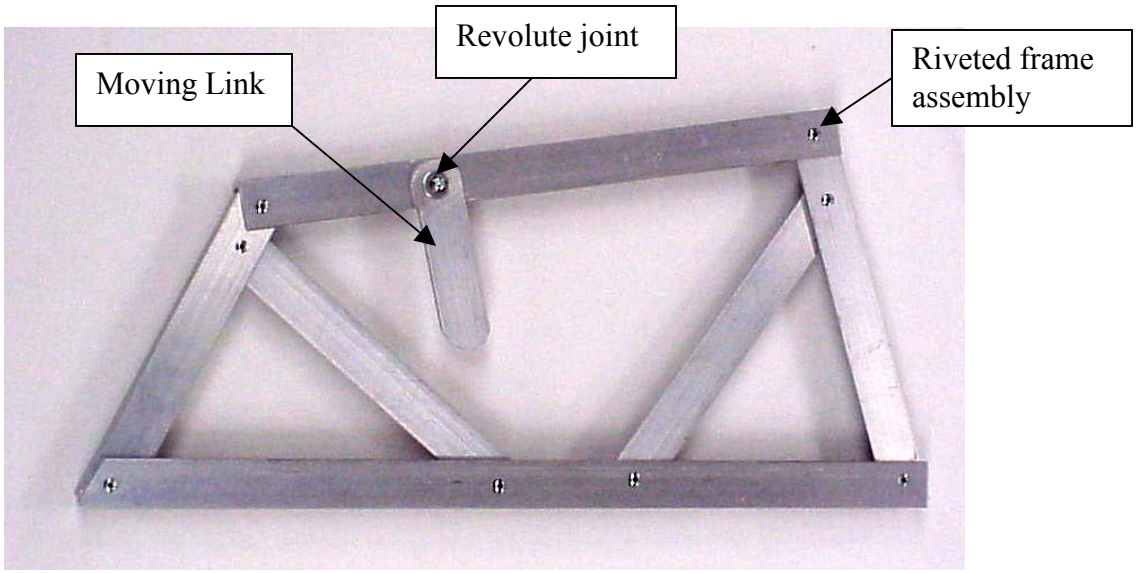


**Figure 3 Typical assembly of a frame using angle and flat stock stiffeners and rivets.**

**12VDC Van Door Motor** - the motor is to be used for powering your mechanism. The no-load speed of the motor is 75 RPM. The stall torque is 325 in-lb. You can assume a linear relationship between torque and speed for this motor. A steel mounting plate for the motor will be provided for each team. Due to a limited number of motors, teams will have to share the motors.

**Figure 4 12VDC van door motor for driving your mechanism**

**Motor Shaft Adapter** – An aluminum adapter will be available for connecting a crank arm to the motor. A solid model of the adapter is shown below.

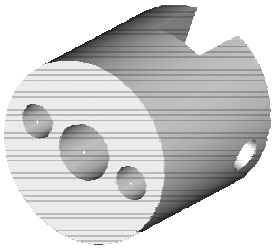

**Figure 5 Adapter for motor shaft**

**Chair** - two wooden chair seats are available for attachment to your mechanism. Your mechanism will be secured to the bottom of the seat using wood screws.

**Figure 6 I-DEAS solid model of the chair seat assembly and the actual seat.**

**Driving Dyad -** In most cases, your four-bar mechanism will need to have a driving dyad added to enable it to run using the motor. The driving dyad consists of a crank and a connector link. You can attach the connector link to any convenient point on your input link, output link or even your coupler. An example of a driving dyad attached to a four-bar rocker mechanism is shown below.

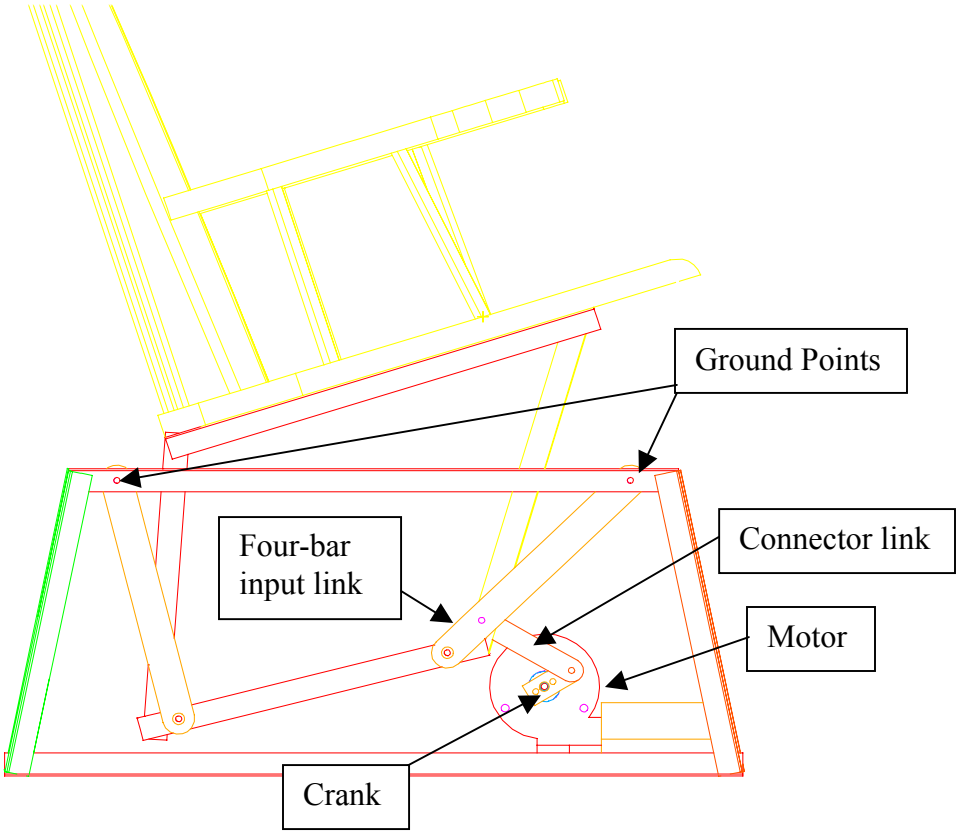


**Figure 7 Four-bar rocker mechanism driven by a dyad connected to a motor.**

**IDEAS Models:**

The chair seat has been modeled as an assembly in I-DEAS for you to use. It is located in a library called *Rocker Parts* under the project called *EM477-Prof. Link*. Copy the chair assembly from this library into your model file. Make sure you select the Copy option, not the Check out option. When you bring the chair assembly onto your workbench, you will see a large cube on the seat. This is simply a mass added to the assembly to simulate a 200 lb. payload.

A solid model of the motor, the motor shaft and the shaft adapter are also contained in this library. You can make copies of these items in your model file as well.

You do not need to include the detailed joint designs in your I-DEAS model. It is sufficient for analysis purposes in this project to create the joints between the holes in the members that will contain the physical bearings and shoulder bolts.